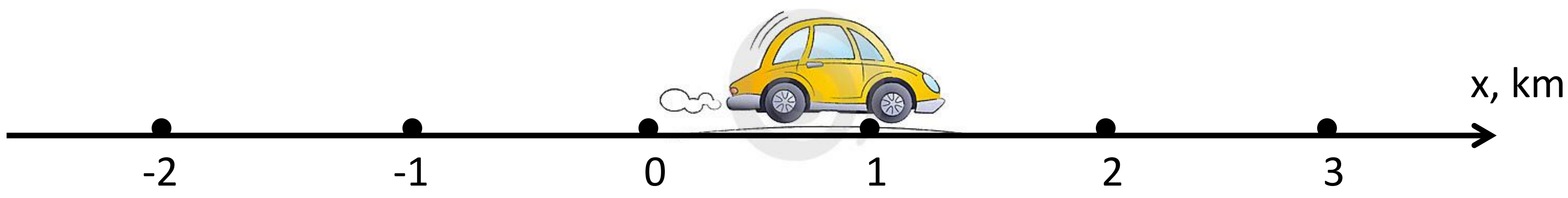
Instantaneous Velocity and Speed



Earlier, we defined ***Average velocity:*** between times t_i and t_f:

$$\boxed{v = \frac{\Delta x}{\Delta t}}$$

$x_i \longrightarrow$ Initial position $\quad x_f \longrightarrow$ Final position

$\Delta x = x_f - x_i \longrightarrow$ Displacement

$\Delta t = t_f - t_i \longrightarrow$ Travel time

Instantaneous velocity tells you how fast an object moves *right now* , at specific time t. The formula is the same as above, but **Δt must be as small as possible.** Similarly, we can define ***instantaneous speed***.

Acceleration

- **Acceleration:** $$a = \frac{\text{change in velocit y}}{\text{change in time}} = \frac{\Delta v}{\Delta t}$$

Standard units of acceleration : m/s^2

- **If there were no air resistance, <u>all</u> objects in Earth gravity would fall with the same acceleration,**

$g=9.81\ m/s^2$

(directed downward)

Galileo Galilei's experiment in Pisa (possibly, a legend)

HOMEWORK

Problem 1

A car of length L=4.0m is moving on a road. Its position is determined by three photo-gates (like we did in class): Gate 1, Gate 2, and Gate 3. The table below shows the times at which each gate gets blocked and unblocked (t_1 and t_2) in seconds:

GATE #	t_1 ,s (gate blocked)	t_2 ,s (gate unblocked)	v, m/s
Gate 1	0.000	0.120	
Gate 2	5.210	5.300	
Gate 3	7.070	7.140	

a) Find the instantaneous speed of the car at the moments when it passed each gate and fill the blanks in the table.

b) Find the average speed between the gates 1 and 2 if the distance between them is D=200m.

c) Find acceleration of the car as it moves between Gate 1 and 2, and between Gate 2 and 3.

d)*(optional) Estimate the distance between gates 2 and 3.

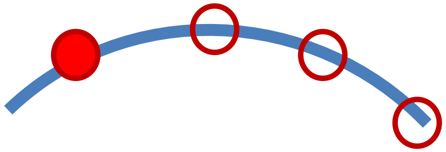
Feel free to use calculator. Show your work.

Problem 2

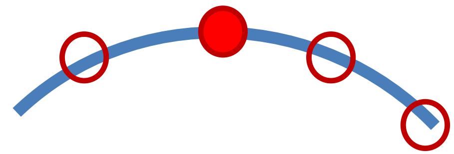
An object thrown at a certain angle follows the trajectory:

On each step of its trajectory, draw the direction of the acceleration:

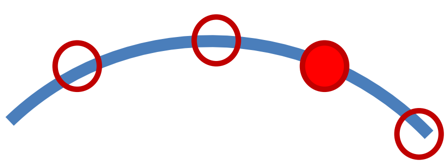
a)



b)



c)



d)